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ABSTRACT

Research shows that one of the most important prerequisites for student success is for teachers to understand and respect individuals from different cultures, and to understand the communities from which they come (Ilmer, Synder, Erbaugh & Kurtz, 1997). Thus, if we want students to succeed, what they bring into the science classroom in terms of belief simply cannot be ignored; fundamental beliefs have considerable impact on learning (Cooper, 1996). Two of the aims of the Rural Systemic Initiatives Program (RSI), which is working in 21 of Louisiana's rural, economically disadvantaged parishes, are to address barriers to systemic and sustainable improvements in science and to adapt high quality, challenging curricula to address cultural diversity. With these aims in mind, a study was undertaken of 155 college freshman biology students in order to ascertain their preconceived beliefs about the subject of evolution. At the end of their course, students were given a survey in which they were asked to respond to questions pertaining to their own high school biology education, and to their beliefs concerning science, religion, and evolution. The survey consisted of 11 items requiring a response based on a 5-point Likert scale. Four additional items required a yes/no response. Demographic data were obtained, and results compared in order to obtain a description of the sample. The results showed that there are differences between the two groups, however none were statistically significant, Although the students as a whole appeared to be more accepting of evolution than of creationism, a large percentage considered creationism, belief, and supernatural explanations as being a part of science. These findings suggest that science instruction in the rural parishes may be less effective due to cultural beliefs and to understandings regarding scientific study that students bring into the classroom. (Contains 16 references and 2 tables.) (Author/DDR)

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THE IMPACT OF RELIGIOUS BELIEF ON LEARNING IN THE SCIENCE CLASSROOM

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Abstract

Research shows that one of the most important prerequisites for student success is for teachers to understand and respect individuals from different cultures, and to understand the communities from which they come (Ilmer, Snyder, Erbaugh & Kurz, 1997). Thus, if we want students to succeed, what they bring into the science classroom in terms of belief simply cannot be ignored; fundamental beliefs have considerable impact on learning (Cooper, 1996).

Two of the aims of the Rural Systemic Initiatives Program (RSI), which is working in 21 of Louisiana's rural, economically disadvantaged parishes, are to address barriers to systemic and sustainable improvements in science and to adapt high quality, challenging curricula to address cultural diversity. With these aims in mind, a study was undertaken of 155 college freshmen biology students in order to ascertain their preconceived beliefs about the subject of evolution. At the end of their course, students were given a survey in which they were asked to respond to questions pertaining to their own high school biology education, and to their beliefs concerning science, religion, and evolution. The survey consisted of 11 items requiring a response based on a 5-point Likert scale. Four additional items required a yes/no response. Demographic data were obtained, and results compared in order to obtain a description of the sample.

The results showed that there are differences between the two groups, however none were statistically significant. Although the students as a whole appeared to be more accepting of evolution than of creationism, a large percentage considered creationism, belief, and supernatural explanations as being a part of science. These findings suggest that science instruction in the rural parishes may be less effective due to cultural beliefs and to understandings regarding scientific study that students bring into the classroom.

Introduction

Evolution has been identified as a major unifying theme in science that transcends disciplinary boundaries (National Research Council, 1996). Lerner (2000) states, "almost all science is the study of the evolution of one system or another," (p. 287) while Rutledge and Warden (2000) maintain "without question the most powerful theory within the field of biology is that of evolution" (p. 23). Given its seminal nature, evolution must be studied if students are to become scientifically literate citizens (Meadows, Doster, & Jackson, 2000).

Lerner (2000) investigated how well different states treated the theory of evolution in their statewide academic standards and concluded that thirty-one were doing at least a satisfactory job. He criticized, however, many states for avoiding the word 'evolution', for poor teaching of the subject, or for deleting references to the age of the earth or the universe. In Louisiana, the benchmarks for the life sciences include the study of evolution, but in spite of this requirement, 23 % of Louisiana biology teachers place little or no emphasis on evolution instruction (Aguillard, 1999).

The fact that many students have had little to no exposure to the theory of evolution at high school level means that they arrive at college "unprepared both emotionally and academically to confront the more rigorous curriculum" (Sinclair, Pendarvis, & Baldwin, 1997, p. 118). In a study undertaken by Cherif, Adams, and Loehr (2001), it was shown that "there is a significant correlation between the nonacceptance of evolutionary theory, the misunderstanding of evolutionary theory and, the basic misunderstanding of the nature of science itself" (p. 570). For students who lack such an understanding, the teacher must be prepared to lay the groundwork in a way that facilitates the acceptance of the theory. This may necessitate explicit

teaching about the way science works, the origins of the theory of evolution, and what the theory actually expounds (Rutledge & Warden, 2000).

Good teaching involves the identification and removal of barriers to learning. In the case of evolution, one of the major barriers to learning appears to be the relationship between evolutionary theory and religion (Sinclair & Baldwin, 1995; Lerner, 2000). Nord (1999) describes four distinct positions that might be taken with regard to science and religion: religion trumps science, science trumps religion, independence, and integration. The position students adopt on this issue will profoundly influence how they view the subject of evolution (Cooper, 1996; Sinclair, Pendarvis, & Baldwin, 1997). Clearly then, what students bring into the classroom in terms of beliefs and opinions cannot be ignored if the teacher wishes to have them engage in worthwhile learning experiences.

The population of Louisiana is generally considered to be very religious. More than 70% claim to be Christian, and a small percentage (0.4) Jewish (U.S. Bureau of Statistics, 2000). Students who come from more fundamental religious backgrounds are traditionally taught, and accept, a literal interpretation of the creation story as related in Genesis. For these students, the study of evolution can engender tremendous pressure to reject either their religious beliefs or the theory of evolution (Sinclair, Pendarvis, & Baldwin, 1997). Scharmann (1993) contends that students need to discuss their beliefs about the origin of life and to give reasons why the different arguments are compelling. Downie and Barron (2000) suggest that teachers should present the historical development of evolution and include the importance of hypothesis testing as a way of knowing in the sciences. In addition, these authors also advocate that students be given "the opportunity to debate the relationship between religious and scientific knowledge and to discuss this relationship, particularly in the context of evolution" (p. 144).

The intent of instruction should not be to change the minds of students, but rather to present evidence for evolution in such a way that students will be challenged to reflect, reason, and evaluate the relevant scientific and religious arguments (Lawson & Worsnop, 1992). Sinclair, Pendarvis, and Baldwin (1997) offer several recommendations to biology teachers in order to achieve this goal. Some of these include: using evolutionary theory as a course theme; being extremely careful about how the subject is taught; and, taking the religious beliefs of students seriously. As Johnson (1999) states, "The truly educational approach is to teach the controversy, presenting students with the evidence and arguments that will permit them to make up their own minds." Consequently, the challenge posed to the teacher is to find a suitable way of accomplishing this task.

Method

The Delta Rural Systemic Initiative (DRSI) seeks to improve science, mathematics, and technology education for youth in rural communities. A major goal of this systemic reform is to assess the needs of students in disadvantaged rural areas and implement programs to promote achievement. Rural school systems often lack adequate funding to provide the necessary equipment and supplies that enhance science instruction. Attitudes and assumptions regarding the nature of science may also serve as barriers to achievement. Scientific concepts frequently are criticized for presenting explanations of phenomena that contradict religious teachings. This study was conducted to determine if students from rural areas are less accepting of concepts related to evolution because of their religious beliefs and if these attitudes differ among students

from rural parishes participating in the DRSI and students from other non-Delta RSI (NDRSI) localities.

The participants in this study included students enrolled in an introductory-level science majors biology course designed as a gateway for additional, in-depth study in a number of biology-related disciplines (e.g., pre-medicine, pharmacy, occupational therapy). Topics in this course include biological chemistry, cell structure and function, cellular metabolism, and Mendelian and molecular genetics. All of the topics listed above were presented from a unity and diversity perspective and were covered prior to the introduction of the study of evolutionary theory. Students were questioned at the end of the semester-long course and were asked to complete a survey that assessed attitude towards the study of science, in general, and evolution, in particular (see Table 1). The survey consisted of eleven items requiring a response based on a 5-point Likert scale and four additional items that required a yes/no response. Students were also encouraged to append qualitative comments concerning their comfort level during the discussion of evolution, scientific evidence for evolution that they found particularly compelling, and the identification of any unanswered questions.

Results

Students responded to several questions regarding their previous instruction in biology and attitudes toward the concept of evolution. Cross-tabulation data (see Table 2) suggest that students from parishes included in the Delta RSI are less likely to take advanced level biology courses in high school. Only 30.8% of students from rural parishes indicated that they had taken advanced coursework in biology as compared to 45.8% of students not included in the DRSI

Table 1.

Exit Survey – The Study of Evolution

1- Did you take a high school biology course? A) yes ; b) no
2- Did you take an advanced-level (advanced placement, biology II, gifted/talented) high school biology course? A) yes ; b) no ; c) not applicable
3- Was evolution taught in your high school biology course? A) yes ; b) no

For each of the following statements (#4-#14), indicate whether you:

a) strongly agree
b) somewhat agree
c) neither agree nor disagree
d) somewhat disagree
e) strongly disagree.

4- The study of biology concerns observations and inferences.
5- In science, a "theory" represents a body of knowledge that has been widely studied and is generally accepted.
6- All science stresses functional knowledge not belief.
7- Science provides natural explanations for observed phenomena.
8- Explanations that involve supernatural explanations are beyond the realm of science.
9- Biological evolution explains the diversity and similarity of life, not how life first arose.
10- Evolution should be part of the high school biology curriculum.
11- Creationism should be part of the high school biology curriculum.
12- Evolution and creationism should both be presented in the high school biology curriculum.
13- Someone can agree with the major tenets of evolutionary theory and still believe in a supernatural deity.
14- If you believe in a supernatural deity, you must necessarily reject evolutionary theory.
15- Was your personal "acceptance-level" of evolution affected by the material we discussed in class? A) yes ; b) no

16- What argument(s)/evidence for evolutionary theory did you find most convincing?

17- What areas of evolutionary theory would you have liked to study in more detail?

18- Do you have any unanswered questions concerning the study of evolution? What are they?

19- Did you feel personally challenged or uncomfortable by our discussion of evolution? If so, briefly explain why?

20- Did you at any time feel that you were being asked to "believe" in something that was in direct opposition to your religious beliefs?

21- Please add any other comments you wish to express about the study of evolution.

Table 2.

Cross-tabulation Frequencies Comparing Students From Parishes Included in the Delta RSI With Students From NDRSI Areas on Selected Survey Items.

Survey Item	DRSI Students		NDRSI Students	
	f	%	*f*	%
Did you take an advanced level high school biology course?				
Yes	8	30.8	49	45.8
No	18	69.2	58	54.2
Total	26		107	
Was evolution taught in your high school biology course?				
Yes	19	63.3	77	72.0
No	11	36.7	30	28.0
Total	30		107	
Explanations that involve supernatural explanations are beyond the realm of science.				
Agree	16	76.2	67	79.8
Disagree	5	23.8	17	20.2
Total	21		84	
Biological evolution explains the diversity and similarity of life, not how life first arose.				
Agree	23	95.8	93	92.1
Disagree	1	4.8	8	7.9
Total	24		101	
Evolution should be part of the high school biology curriculum.				
Agree	21	80.8	81	86.2
Disagree	5	19.2	13	13.8
Total	26		94	
Creationism should be part of the high school biology curriculum.				
Agree	17	73.9	58	69.9
Disagree	6	26.1	25	30.1
Total	23		83	

Table 2. (*Continued.*)

Survey Item	DRSI Students		NDRSI Students	
	f	%	*f*	%
Evolution and creationism should both be presented in the high school biology curriculum.				
Agree	17	68.0	62	68.9
Disagree	8	32.0	28	31.1
Total	25		90	
Someone can agree with the major tenets of evolutionary theory and still believe in a supernatural deity.				
Agree	20	74.1	78	87.6
Disagree	7	25.9	11	12.4
Total	27		89	
If you believe in a supernatural deity, you must necessarily reject evolutionary.				
Agree	5	20.8	17	23.0
Disagree	19	79.2	57	77.0
Total	24		74	
Was your personal "acceptance level" of evolution affected by the material discussed in class regarding evolution?				
Yes	12	40.0	38	35.5
No	18	60.0	69	64.5
Total	30		107	

program. Parishes participating in the Delta RSI are identified based on a population density index (Beale Code of 6-9) and the percentage of school-age children that live in poverty (30% or greater). Typically, schools in rural parishes of Louisiana do not have adequate resources to sustain quality science programs. Many of these schools do not offer science courses beyond those required for high school graduation or mandated by the state department of education.

State benchmarks and standards that guide science instruction in Louisiana include evolution as a concept to be included in the biology curriculum. Thirty-seven percent of students living in rural parishes reported that evolution was not taught in their high school biology courses. However, 81% of these students agreed that evolution should be part of the high school biology curriculum. Only 28% of students from NDRSI regions indicated that evolution was not taught in their high school biology courses while 86% of these students agreed that evolution should be part of the high school biology curriculum. These data suggest that more students from rural parishes, rather than NRDSI areas, are currently not receiving state-mandated instruction on the concepts of evolution. A possible explanation for these results is that the religious beliefs of residents in rural communities result in greater opposition to evolutionary theory. In an effort to avoid this opposition, teachers avoid presenting concepts that are perceived by the community as being contradictory to entrenched religious teachings.

In addition to an overwhelming endorsement of evolution instruction, 74% of students from rural parishes agreed with the statement that creationism should be part of the high school biology curriculum whereas only 70% of students from NRDSI areas concurred with this statement. When asked if evolution and creationism should both be presented in the high school biology curriculum, 68% of rural students and 69% of students from NRDSI regions agreed with the presentation of the competing theories. Results from these three items suggest that a higher

percentage of students, regardless of their rural/non-rural origins, feel that the concepts of evolution should be given instructional priority over a curriculum that includes only creationism, or a curriculum that addresses both evolution and creationism. There is a larger difference in the percentage of students from non-rural parishes that disagree on whether evolution alone or creationism alone should be the focus of the high school biology curriculum. Only 14% of students from NRDSI areas disagreed with evolution being a part of the high school curriculum, whereas 30 % of these same students disagreed with the inclusion of creationism. Although the percentage of students from rural parishes that oppose the inclusion of creationism in the curriculum was higher (26%) than the percentage of students opposing the study of evolution (19%), students from less rural areas show greater differences in their degree of disagreement. A slightly larger percentage of students from rural parishes (40%) indicated that their acceptance of evolution was affected by class discussions on evolution. Only 36% of students from other regions indicated an increase in acceptance level. These data suggest that students from rural parishes may have been more biased toward concepts of evolution before the concepts were taught than were students from NDRSI areas.

Discussion and Implications

A preliminary survey of science majors enrolled in an introductory biology lecture course indicates that students can be exposed to the concepts of evolutionary theory in a non-confrontational manner that promotes their willingness to study this important area of biology. When instructors include in their coverage the scope of scientific investigation, hypothesis testing, and the nature of "belief" in the sciences, students overwhelmingly report that they feel

neither challenged nor uncomfortable by discussions of evolutionary theory. Our attempts to uncover significant differences between RDSI and NRDSI student populations did not prove successful in this initial assessment. Rather, the religious conservatism of the area in general, rather than membership in RDSI or NRDSI specific regions, constitutes an important indicator of student religious concerns in the science classroom. Clearly, the regional high school biology curriculum is apparently lacking in its compliance with Louisiana benchmarks for the inclusion of evolutionary theory as an integral part of the biology program. Nevertheless, the present study suggests that students can be exposed to evolutionary concepts that they understand and appreciate from a factual perspective without ever integrating this information into any "bigger picture" of their intellectual experience. Religious concerns certainly play a significant role in this lack of integration.

Currently, the exit survey utilized in the present study is under revision to provide for a more comprehensive assessment of attitudes towards the presentation of evolutionary theory. Plans include: provisions for a pre- and post-evolution discussion survey; a comparison of attitudes amongst science and non-science majors; and, the development of instructional material that can be disseminated to local high school science teachers through the University of Louisiana at Monroe/Howard Hughes Medical Institute Undergraduate Biology Education Program – Pre-College Outreach component.

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